§23. Prototype Negative Ion Source for #2 Injector (BL2) in the LHD-NBI System

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A prototype negative-ion source was constructed and tested for the #2 injector in the negative-ion-based LHD-NBI system. Figure 1 shows a schematic diagram of the ion source. The ion source is a cesium-seeded volume production source equipped with external magnetic filter. The arc chamber of multicusp bucket is rectangular of 35 cm x 145 cm in cross section and 21 cm in depth. The accelerator is a three-grid single-stage one, and the total grid area is 25 cm x 125 cm, which is divided into five sections.

The ion source was installed on the negative-ion-based NBI test-stand, and the H^- current was measured at the beamdump 13 m downstream by water-calorimetry. As shown in Fig. 2, the H^- current was increased with an increase in the arc power, and 25 A of the H^- current was obtained with an energy of 104 keV. The pulse length was 1 sec, and the operational gas pressure was as low as 2.8 mTorr. The large area beam was successfully focused by both the geometrical arrangement of five grid sections and the aperture displacement technique of the grounded grid [1], and the averaged divergence angle was about 10 mrad, which satisfies the LHD-NBI specification.

The long-pulse operation was also tested, and 81 keV - 1.3 MW of the H^- beam was incident on the beamdump for 10 sec, as shown in Fig. 3.

These results enable to inject 2.5 MW of the neutral beam into the LHD plasma with the BL2, in the second campaign of the LHD experiments.

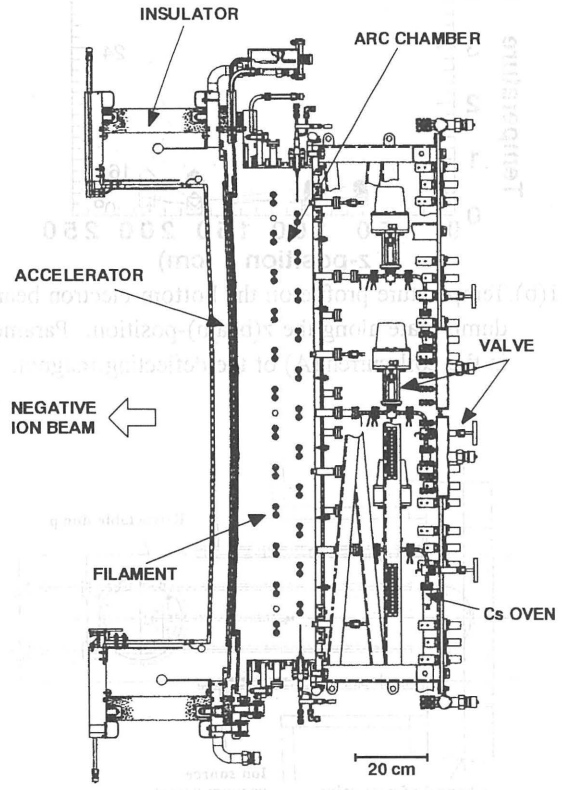

Fig. 1. Schematic diagram of a prototype negative ion source for BL2.

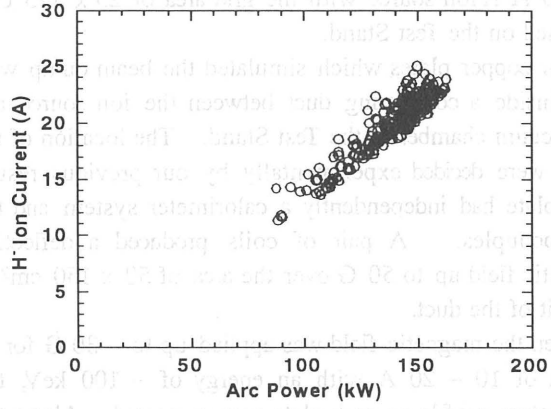

Fig. 2. H^- ion current as a function of the arc power.

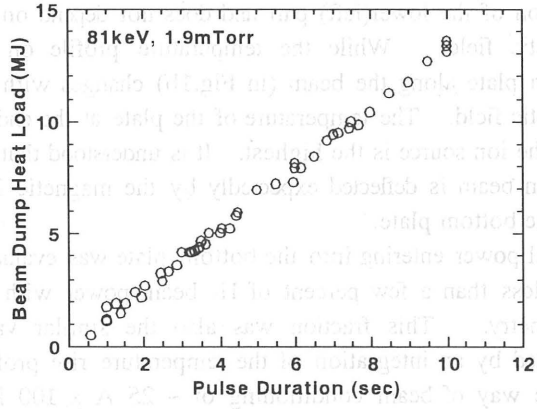

Fig. 3. Beam dump heat load as a function of the pulse duration.

Reference

[1] Y. Takeiri, *et al.*, Rev. Sci. Instrum. **66**, 5236 (1995).